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RESEARCH ARTICLE

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Are psychological status and trust in information related to vaccine hesitancy during COVID-19 pandemic? A latent class and mediation analyses in Italy

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ABSTRACT

Despite the recognized benefits of the COVID-19 vaccination, vaccine hesitancy (VH) remains one of the biggest challenges of the mass vaccination campaign. Most studies investigating VH determinants focused on socio-demographics and direct relationships. In this study, we aimed at: 1) identifying subgroups of people differently affected by the pandemic, in terms of psychological status; 2) investigating the role of psychological status and trust in information as possible mediators of the relationship between individual characteristics and VH. To this purpose, a latent class analysis (LCA) followed by a mediation analysis were carried out on data from a survey conducted in January 2021 on 1011 Italian citizens. LCA identified four different subgroups characterized by a differential psychological impact of the pandemic: the extremely affected (21.1%), the highly affected (49.1%), the moderately affected (21.8%) and the slightly affected (8%). We found that VH decreased with the increase of psychological impact (from 59.3% to 23.9%). In the mediation analysis, past vaccination refusal, age 45-54 years and lower-than-average income, were all indirectly related to higher VH through mistrust in COVID-19 information. Differently, the psychological impact counteracted the greater VH in females, the negative effect of social media among youngest (<35 years) and the negative effect of mistrust in the lower-than-average-income subgroup. Knowledge of psychological profile of hesitant individuals, their level of trust and the sources of information they access, together with their sociodemographic characteristics provides a more comprehensive picture of VH determinants that can be used by public health stakeholders to effectively design and adapt communication campaigns.

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COVID-19; vaccine hesitancy; psychological impact; trust; mediation model; latent class analysis

Introduction

COVID-19 pandemic has drastically altered people's lives, as well as multiple aspects of the global, public, and private economy.¹⁻³ National governments adopted several interventions to mitigate the impact of the pandemic, with various levels of effectiveness.⁴⁻⁶ Before the COVID-19 vaccine was available, non-pharmaceutical interventions (e.g., stay-at-home measures, self-isolation and closure of non-essential activities) were largely adopted and helped to contain the spread of the virus, mitigating its impact on the population.⁷

Regrettably, these non-pharmaceutical interventions, in conjunction with the anxiety instilled by the pandemic, determined highly significant levels of psychological distress in the general population that, in many cases, met the threshold for clinical relevance.⁸ For instance, a systematic review on the psychological impact of the quarantine on the general European adult population reported a prevalence of anxiety symptoms ranging from 5.5% to 70.4% and a prevalence of psychological distress between 15% and 40%.⁹

Mass vaccination campaigns proved to be the most effective prevention measures, with both health and economic advantages over non-pharmaceutical interventions.¹⁰ Vaccination reduced the overall COVID-19 mortality and number of severe cases (i.e., hospitalizations),¹¹⁻¹³ while facilitating the

reopening of all of the economic structure and non-essential activities.¹⁴ The effectiveness of the mass vaccination has ended in a reduction of the use of non-pharmaceutical containment measures and in alleviating the psychological burden due to the pandemic among vaccine recipients.^{15,16}

Of note, the massive vaccinations campaigns' positive effects were strictly related to the achievement of coverage rates higher than 70% in a short period of time.^{17,18} In light of the importance of achieving high coverage rates, it was necessary to rigorously plan and organize mass vaccination campaigns as well as promote vaccine acceptance by the general population.¹⁹⁻²¹ In this regard, the phenomenon of Vaccine Hesitancy (VH) – described as a “delay in acceptance or refusal of vaccination despite availability of vaccination services” by the SAGE group since 2014²² – posed a major obstacle to the effectiveness of COVID-19 immunization programs.

Even before this pandemic, the World Health Organization (WHO) declared VH as one of the 10 global health threats.²³ Over the past few years, there has been a stronger need to fully understand the phenomenon and to find solutions to counter it. In order to monitor and understand the reasons why a considerable number of people do not receive recommended vaccinations, various models have been proposed. In 2015, the

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SAGE working group described the so-called 3Cs model, in which Confidence, Convenience and Complacency were considered as the main factors of VH.²⁴ Other models (e.g., 4Cs, 5As) and scales (e.g., Global Vaccine Confidence Index Scale and 5Cs antecedents of vaccine acceptance) have been proposed over the years,^{25–29} emphasizing once again how extremely complex the phenomenon of VH is. In 2022, among the behavioral and social drivers (BeSD) of vaccine uptake, WHO considered aspects such as thinking and feeling, social processes, motivation, and practical issues to be of particular importance. Drivers more pertinent to people's psychological and attitudinal areas, such as cognitive and emotional responses to vaccine-preventable diseases, vaccine-related experiences, and willingness, were therefore included in the BeSD framework.³⁰

VH for COVID-19 has been much studied during the pandemic, especially in light of the uneven uptake rates achieved globally.^{31,32} According to a recent review and meta-analysis, the specific uptake and acceptance rates for COVID-19 varied among countries, ranging from 35.9% (34.3–37.5) to 86.9% (81.4–92.5). In addition, some people more prone to hesitancy were identified: females, people aged <60 years old, black individuals, and people with lower education or income.³³

Even before the pandemic, VH has often been associated with a lack of trust^{34,35} emphasizing how trust remained, however, an 'ill-defined' and 'loosely measured concept'.³⁴ The need to further study the relationship between trust and vaccine acceptance became even more clear in light of the conspiracy beliefs that arose during the pandemic.^{36,37} In addition, according to some recent studies analyzing psychological status, anxiety and COVID-19 related fear have been shown to be associated with higher vaccine acceptance, while self-centeredness and emotional instability were more frequently observed among hesitant people.^{38,39} These findings underscore that the psychological status is also of utmost importance in understanding VH and uptake.

In this study, we used data collected in the midst of the pandemic and before the vaccine campaign to investigate the main factors and determinants of VH in Italy, including some of the BeSD drivers. Specifically, we focused on the possible mediating role of trust in information and psychological impact of the pandemic in the relationship between individual characteristics, sources of information and VH. In order to do so, we first characterized subgroups differently affected by the pandemic in terms of psychological status and concerns related to COVID-19 infection using latent class analysis. Then, we used these subgroups to expand a previously developed model, in which the use of different information sources proved to mediate the effect of individual characteristics on VH.⁴⁰

Materials and methods

Study setting and participants

A cross-sectional online survey was conducted in January 2021 on a representative sample of citizens aged 18–70 living in Emilia-Romagna region, Northern Italy. The age of the respondents was limited to adults under 70 years due to the nature of data collection through an online platform. Moreover, the

survey was administered only to Emilia-Romagna residents because Italian regions are responsible and autonomous for the local organization and delivery of health care and the survey aimed at providing information to regional stakeholders. Details on the recruitment method and data collection were described previously.⁴⁰

Measures

Willingness to get vaccinated against COVID-19 was rated as 'very likely,' 'somewhat likely,' 'not sure,' 'not in the next two months but would consider it in the future,' 'somewhat unlikely,' 'very unlikely.' VH was defined as present when the response to this question spanned 'not sure' to 'very unlikely.'

Five questions measured people's feelings related to the pandemic. Specifically, participants were asked to indicate how much they were: anxious with the increase in the number of COVID-19 cases, angry for the conflicting information about COVID-19, distressed for not being able to plan life, depressed due to the uncertainty on pandemic evolution and excited for the arrival of a vaccine. The levels of anxiety, anger, depression, distress, and excitement were rated on a Likert scale from one to four ('not at all,' 'a little,' 'somewhat,' 'very much'). Three items measured concerns about being infected at work, being infected outside working place, and infecting others, and were rated with the same Likert scale of feelings. See supplementary Table S1 for more details.

Moreover, people were asked about how accurate was in their opinion the number of COVID-19 cases officially reported (somewhat accurate, under-reported, over-reported). This question was considered as a proxy of trust in official COVID-19 information and was dichotomized into accurate vs. non-accurate, for ease of interpretation.

Theoretical model

In a previous study, we focused on the effect of information sources as mediators of the relationship between individual characteristics and VH. Individual characteristics included: age, gender, education, family income, presence of comorbidities, past vaccination refusal and perceived risk of infection. The results showed that the use of social media reinforced VH while the use of institutional websites reduced it.⁴⁰

Based on recently emerged literature stressing the importance of considering people's psychological status influencing VH,^{38,39} we hypothesized that both the perceived risk of infection and feelings related to the pandemic were measures of the psychological impact of the COVID-19 pandemic. Specifically, we used the five items measuring feelings and the three items measuring perceived risk to identify subgroups affected differently by the COVID-19 pandemic in terms of psychological consequences.

Similarly, trust in institutions and science has been reported as a determinant of VH.^{10,35,41,42} Consequently, we used the perceived accuracy of the number of COVID-19 cases officially reported as a proxy measure of trust in official COVID-19 information.

In this perspective, we added the psychological impact together with trust in official COVID-19 information as

further possible mediators of the relationship between individual characteristics (e.g., socio-demographic and economic characteristics) and VH. In addition, we hypothesized that the use of different information sources would reflect different levels of trust in COVID-19 information, and both the information sources and trust would affect the psychological status. In summary, we constructed a theoretical model depicting the path from individual non-modifiable factors to VH, passing through modifiable factors, such as behaviors (use of media), beliefs (trust in information) and perceptions (psychological impact of the pandemic) as shown in [Figure 1](#).

Statistical analysis

This study is a secondary analysis of the survey data; thus, the sample size was not determined for SEM estimation purposes. However, using the rule of thumb proposed by Bentler and Chou that suggests including at least 10 observations per estimated parameter,⁴³ we can conclude that the sample size is sufficient to estimate all the hypothesized associations depicted in [Figure 1](#).

Eight ordinal variables measuring feelings and concern about infection were used to build a latent-class model to identify subgroups of people differently affected by the pandemic. Latent class analysis (LCA) with maximum likelihood estimation was used and models with two to five classes were estimated. Each model was replicated 10 times to search for a global, and not just a local, maximum of log-likelihood function. The determination of the optimal number of classes was based on interpretability of classes, a sufficient number of cases per class ($\geq 5\%$, i.e., 50 participants) and three common goodness of fit indices: likelihood ratio test, Bayesian Information criterion (BIC) and entropy. The likelihood ratio test compares the model with k classes and the model with $k + 1$ classes, and a significant difference indicates a better fit of the more complex model. Lower values of BIC indicate better fit. Entropy is a measure of classification uncertainty and values > 0.80 indicate that the latent classes are highly separated.⁴⁴

Classes (denoting the level of psychological impact of the pandemic) were compared on socio-demographic and

behavioral characteristics using Pearson's χ^2 test for categorical variables and ANOVA for continuous variables.

Finally, the level of psychological impact of the pandemic was used as a mediator in a structural equation modeling analysis. The mediation model depicted in [Figure 1](#) was initially estimated and simplified through backward stepwise selection. Goodness of fit to the data of the final mediation model was assessed using the χ^2 , CFI, TLI, AGFI, RMSEA and SRMR indices.^{45–48} Results were reported as standardized regression coefficients (std b) to allow comparison of effects; direct, indirect, and total effects (β) were estimated.

All statistical analyses were conducted using R statistical software 4.0.5 (R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>). LCA was performed using poLCA package,⁴⁹ while the mediation model was estimated using the sem package.⁵⁰

Results

Characteristics of the sample

The study population had a mean age of 46.9 ± 11.5 years, 55% were female, 36.5% had a university degree and 71.3% were employed. TV was the mostly used source of information about the pandemic (71.9%), while social media were the least used source (18.9%). Comorbidities related to the risk of severe COVID-19 disease were reported by 28.4% of the sample and 9.2% had a diagnosis of COVID-19; 158 (15.6%) reported to have refused a vaccination in the past and 314 (31.1%) reported to be hesitant toward the COVID-19 vaccine. See supplementary table S2 for more details.

Psychological impact of the pandemic: latent class analysis

The goodness of fit indices for 2 up to 5 classes models are shown in supplementary table S3. There was no concordance between the various goodness of fit indices in the suggested optimal number of classes, with entropy indicating the 2-class model, BIC indicating the 4-class model and the likelihood

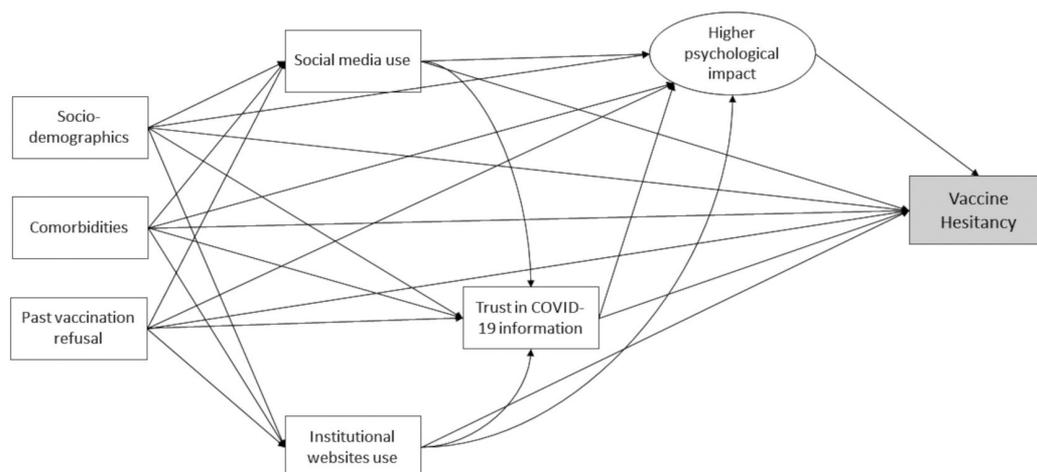


Figure 1. Theoretical mediation model including domains predicting vaccination hesitancy.

ratio test indicating the 5-class model. Because the addition of a 5th class resulted in a less interpretable classification as compared to the 4-class solution (see Supplementary Figure S1), we retained the 4-class model as the best for distinguishing subgroups of people differently affected, from a psychological point of view, by the COVID-19 pandemic.

Figure 2 shows the mean scores of the indicators used to define the classes. Classes were ordered with respect to indicators mean values from the one with the lowest to the one with the highest values. Class 1 was the smallest and included 81 people (8.0%). Based on the lowest mean values for most of indicators, this subgroup was denominated as *slightly affected* by the COVID-19 pandemic. On average, people in this subgroup were somewhat angry and distressed, less depressed, less worried to infect other people and not so much excited for the vaccine arrival; moreover, they had almost no anxiety and no concern about being infected. Class 2 comprised 21.8% of sample and was characterized by people somewhat angry and stressed as class 1 but more excited for vaccine arrival and

more worried to infect others. People in this class were also a little worried to be infected, somewhat anxious and depressed. This subgroup was denominated *moderately affected* by the COVID-19 pandemic. Class 3 included around half of sample (49.1%) and was characterized by a mean value of all the indicators around 3, thus it was denominated *highly affected* by the COVID-19 pandemic. Finally, class 4 included 21.1% of sample reporting the highest mean values for all the indicators from a minimum of 3.3 for excitement about the arrival of a vaccine up to 3.9 for concern about infecting other people. This subgroup was denominated the *extremely affected* by the COVID-19 pandemic.

Characteristics and VH of people with a different psychological impact of the pandemic

A higher psychological impact of the pandemic was associated with a lower VH ($p < .001$, Table 1). In particular, the proportion of hesitant people ranged from 23.9% in class 4 (*Extremely*

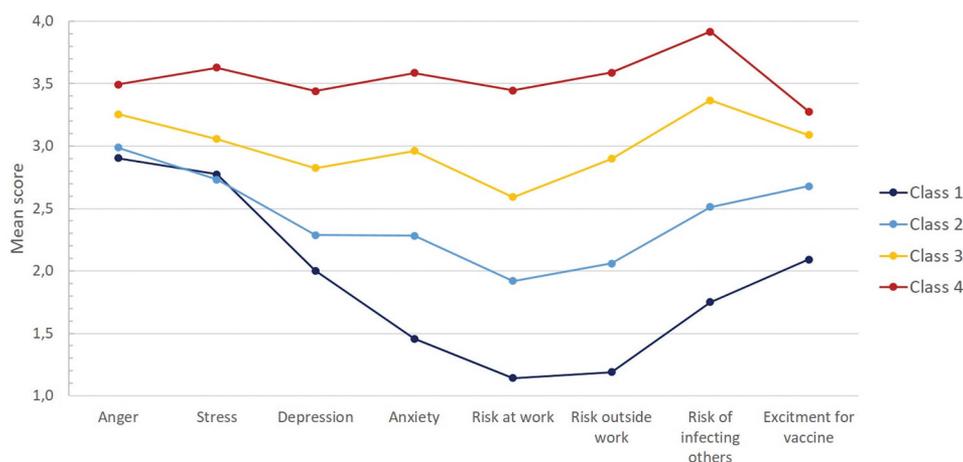


Figure 2. Mean score of the eight indicators measuring psychological impact of the pandemic for each latent class.

Table 1. Comparison between classes with respect to socio-demographic and other characteristics.

	Class 1 (N=81)	Class 2 (N=221)	Class 3 (N=496)	Class 4 (N=213)	p-value
Socio-demographic characteristics					
Female, n (%)	37 (45.7)	97 (43.9)	284 (57.3)	140 (65.7)	<.001
Age, mean \pm SD	48.0 \pm 10.8	48.4 \pm 11.1	46.5 \pm 11.6	45.9 \pm 11.7	.084
University degree, n (%)	28 (34.6)	76 (34.4)	187 (37.7)	78 (36.6)	.834
Employed, n (%)	54 (66.7)	170 (76.9)	356 (71.8)	141 (66.2)	.071
Income, n (%)					.001
Lower than average	29 (35.8)	57 (25.8)	139 (28.0)	91 (42.7)	
On average	42 (51.9)	134 (60.6)	308 (62.1)	107 (50.2)	
Higher than average	10 (12.3)	30 (13.6)	49 (9.9)	15 (7.0)	
Num. family members, median [IQR]	3 [2–4]	3 [2–4]	3 [2–4]	3 [2–3]	.471
Any old family member (>70 years), n (%)	56 (69.1)	151 (68.3)	373 (75.2)	153 (71.8)	.235
Use of information sources					
TV, n (%)	46 (56.8)	160 (72.4)	358 (72.2)	163 (76.5)	.009
Press, n (%)	29 (35.8)	88 (39.8)	230 (46.4)	91 (42.7)	.181
Social media, n (%)	15 (18.5)	45 (20.4)	92 (18.5)	39 (18.3)	.939
Institutional websites, n (%)	28 (34.6)	66 (29.9)	213 (42.9)	89 (41.8)	.006
COVID-19 related characteristics					
Presence of comorbidities, n (%)	20 (24.7)	54 (24.4)	140 (28.2)	73 (34.3)	.118
COVID-19 diagnosis, n (%)	7 (8.6)	18 (8.1)	47 (9.5)	21 (9.9)	.923
Income reduction due to COVID-19 pandemic, n (%)	25 (30.9)	50 (22.6)	149 (30.0)	71 (33.3)	.083
Trust in COVID-19 official information, n (%)	21 (25.9)	102 (46.2)	269 (54.2)	103 (48.4)	<.001
Vaccine related characteristics					
Past vaccination refusal, n (%)	19 (23.5)	39 (17.6)	68 (13.7)	32 (15.0)	.117
Hesitancy toward COVID-19 vaccine, n (%)	48 (59.3)	84 (38.0)	131 (26.4)	51 (23.9)	<.001

affected) to 26.4% in class 3 (*Highly affected*), 38% in class 2 (*Moderately affected*), up to 59.3% in class 1 (*Slightly affected*).

The four classes were significantly different also for socio-demographics and other characteristics as shown in [Table 1](#). People in class 1 (*Slightly affected*) reported a lower use of TV for informing themselves, a lower trust in COVID-19 information, and more frequently a previous vaccination refusal, as compared to the other three classes. Class 2 (*Moderately affected*) was instead the wealthiest including the lowest proportion of people with a lower-than-average-income (25.8%) and the highest proportion of people with higher-than-average-income (13.6%), it was characterized by a higher proportion of employed people and a lower proportion of people experiencing income reduction due to the pandemic. As compared to the other two classes, class 3 (*Highly affected*) and class 4 (*Extremely affected*) had a lower mean age, comprised a significantly higher proportion of females and a higher proportion of people consulting institutional websites ([Table 1](#)).

Mediation model to predict VH

[Figure 3](#) shows the final mediation model. Four mediators of the relationship between individual characteristics and VH were identified, i.e., social media use, institutional websites use, trust in COVID-19 information and psychological impact of the pandemic. Specifically, a higher psychological pandemic impact was associated with a reduced VH (std b = -0.188 , $p < .001$). The use of institutional websites and trust in official COVID-19 information were both directly and indirectly related to lower VH through a higher psychological impact, while social media use was only directly related to higher VH. No significant association was found between the use of social media or institutional websites and trust in official COVID-19 information.

As to socio-demographic variables, compared to the older age class (≥ 55 years), age 35-44y was directly and indirectly associated with higher VH through a higher social media use, age 45-54y was indirectly associated with higher VH through

a lower use of institutional websites and a lower trust in COVID-19 information, while age 18-34y was associated with a higher use of social media but also higher psychological impact resulting in a null total effect on VH ($\beta = 0.007$, $p = .645$). Similarly, female gender was directly associated with higher VH but also associated with a higher psychological impact resulting in a negative indirect effect and in a non-significant total effect on VH ($\beta = 0.053$, $p = .187$). As compared to on-average income, lower-than-average income was associated with a lower trust in COVID-19 information but also with a higher psychological impact of the pandemic, resulting in a non-significant total effect on VH ($\beta = 0.021$, $p = .154$); on the contrary, higher-than-average income was indirectly associated with lower VH through higher use of institutional websites. The association between higher education and lower VH was only direct.

Comorbid conditions were directly related to lower VH but also indirectly associated through several mediators. Indeed, comorbid conditions were related to higher psychological impact, higher institutional websites use, but also higher social media use resulting in a non-significant indirect effect.

Finally, past vaccination refusal was directly related to higher VH, but also indirectly related to VH through a lower trust in COVID-19 information.

Details on direct, indirect and total effects on VH are reported in supplementary [Table S4](#). Fit indices indicated a good fit to the data: $\chi^2(df = 30) = 30.2$, $p = .457$; RMSEA = 0.002 (95% CI: 0.000-0.024); SRMR = 0.024; TLI = 0.999; CFI = 0.998; AGFI = 0.922.

Discussion

Psychological impact of the pandemic

In this paper, we identified different subgroups of the general population during the acute phase of COVID-19 pandemic, based on psychological status and risk perception. Findings from LCA indicate four different groups characterized by

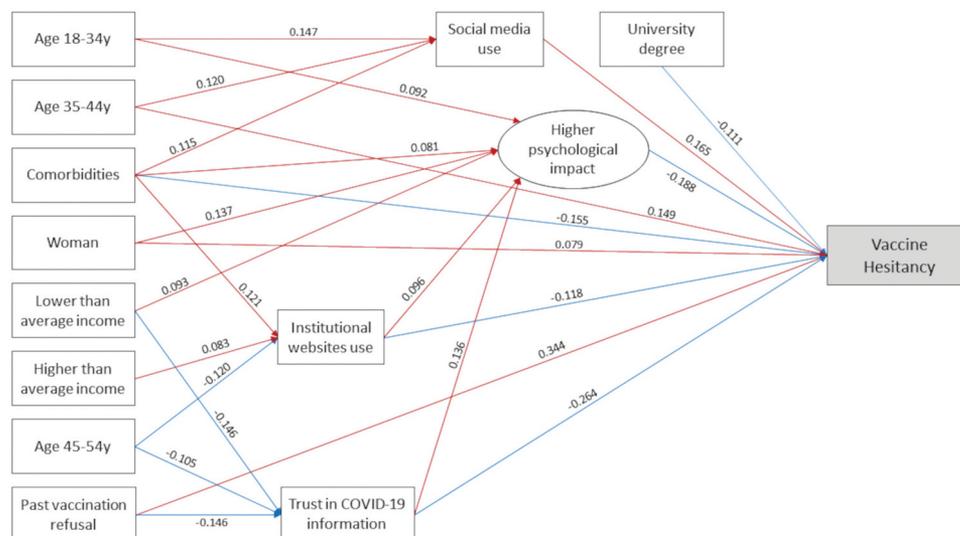


Figure 3. Estimated mediation model including factors predicting vaccination hesitancy. The red line denotes a positive effect, and the blue line denotes a negative effect. The numbers represent standardized regression coefficients.

a gradual increase in the level of the psychological impact, namely: the *extremely affected*, the *highly affected*, the *moderately affected* and the *slightly affected* by the pandemic. Other studies have investigated the COVID-19 pandemic impact in terms of concerns and anxiety⁵¹ or perceived risk and preventive behavior.^{52,53} Similarly, to our study, they used the LCA and found an increasing level of COVID-19 impact among different classes, for example Horn and colleagues⁵² identified three subgroups: the least, the more and the most affected by the COVID-19 pandemic. However, these studies were conducted on specific sub-groups, university students,⁵¹ older adults⁵² and social media users⁵³ while our study concerns the general population.

The *extremely* and the *highly* affected subgroups included 70% of participants and were characterized by a higher frequency of females, younger mean age and lower income as compared to the *slightly* and the *moderately* affected subgroups. Other studies reported an association between female gender and increased psychological distress caused by the pandemic.^{51,52,54,55} This result may be related to higher fear and anxiety responses of women related to a perceived higher vulnerability along with an increased risk of developing post-traumatic symptoms as compared to men.^{55–58} Similarly, the association between young age, low-income and greater psychological impact of the pandemic is consistent with evidence from other studies.^{9–59–61} Both these associations may be explained by the greater consequences of lockdown and restriction measures among these subgroups. For instance, university students were the first experiencing the effect on daily life caused by restriction measures such as online learning and social and sports activities forced interruption. In addition, people with low economic sources are more likely to live in smaller houses with limited space for privacy that could have amplified the mental health consequences of lockdown and restriction measures. Finally, it cannot be ignored the impact that the pandemic has had on temporary and lower-wage workers who have lost or have been at risk of losing their jobs to a greater extent than others.

In our study, we found a significant decrease in VH with the increase of psychological distress and perceived risk. This result can be explained by the fact that the pandemic phase at that time mostly affected respondents' lives, thus many people were likely to see vaccination as a self-protective measure as well as an act of social responsibility with beneficial effects for all rather than just oneself. Indeed, the pandemic brought to light the interdependencies between people and countries, hence people have become more aware that the achievement of their personal goals depends, now more than ever, on the choices made by other society members.⁶² However, as reported in another study, the correlation between vaccine acceptance and psychological distress should not be exploited to promote vaccine acceptance by stoking fears, stress, and anxiety in the general population.³⁸ Rather, it is likely that the *extremely* and *highly affected* subgroups are more sensitive to community issues, while less affected people may be characterized by a more self-centered attitude and perception of the consequences of the pandemic. Indeed, we also found that the *slightly affected* subgroup was characterized by a significantly lower proportion of people trusting the official COVID-19

information, that is, a lower proportion of people perceiving the real burden of COVID-19 pandemic. This result was confirmed in the mediation model, where trust in official COVID-19 information was both directly and indirectly related through a higher psychological impact with a lower VH.

The mediating role of trust in information sources and psychological impact of the pandemic on vaccine hesitancy

As compared to the mediation model reported previously,⁴⁰ the positive effect of obtaining information through institutional sources and the negative effect of social media use on vaccine acceptance were confirmed, although these relationships were not mediated by trust in official COVID-19 information as initially hypothesized. The absence of an association between sources of information and trust in COVID-19 information could be related to the fact that the official number of cases reported was the same across different information sources, thus trust depends more on personal attitudes rather than the type of channel used. On the other hand, relying on institutional sources was indirectly associated with lower vaccine hesitancy through a higher psychological impact. Evidence from the literature suggests an association between the use of healthcare sources and higher perceived risk.³⁹ These findings indicate that people who frequently consult institutional sources may be more aware of the importance of vaccination in counteracting the pandemic.

As to individual characteristics (i.e., socio-demographics, comorbidities and past vaccination refusal), all the effects on VH, direct and indirect through the use of information sources, found in the previous mediation model were confirmed.⁴⁰ In this study, in addition, we found a significant direct and positive effect of woman on VH and other indirect effects through trust in official COVID-19 information and psychological pandemic impact. Specifically, past vaccination refusal, age 45–54 years and lower-than-average income, were all indirectly related to higher VH through a lower trust in COVID-19 official information. These results, are in line with literature reporting that trust in information, in informative sources and in institution is a crucial mediator in determining willingness to accept vaccine.^{62–65} Mistrust of official information may be indicative of a conspiracy mind-set perceiving evidence that vaccines are helpful as misleading and covering up evidence that vaccines are harmful.⁶⁵ Conspiracy theories and mistrust have greater appeal on younger-age and low-income population as also demonstrated by others.^{66–69}

Finally, being psychologically involved with the pandemic counteracted the greater VH in females, the negative effect of social media use in the subgroup of young adult (<35 years) and the negative effect of lower trust associated with the lower-than-average-income subgroup. As a result, the total effect of female gender, young age and low-than-average-income on VH was not statistically significant. The findings of this study underscore the importance of emphasizing the prosocial benefits of vaccination when promoting it, as well as implementing targeted communication campaigns to specific subgroups like females that are known to be at higher risk of vaccine refusal.^{70,71}

Study limitations

These findings should be interpreted in light of several limitations. First, due to the cross-sectional study design, the causal relationship between variables cannot be determined. Secondly, these data were collected during the early weeks of the vaccination campaign in Italy. At this time, only healthcare personnel were vaccinated. Therefore, the willingness to be vaccinated, as well as the level of perceived risk and psychological distress, may have changed in the subsequent weeks. This is because both VH and pandemic perception are dynamic processes. On the other hand, data collected before the vaccination campaign provide insight that can help prepare for future emergencies or viruses that may require mass vaccination. Third, despite the fact that the sample is representative, the results cannot be generalized to the overall Italian population for two reasons: the sample was limited to adults up to 70 years and the survey was administered in a specific geographical area (Emilia-Romagna region in Northern Italy). Fourth, variables included as feelings indicators are not validated measures of the underlying constructs (anxiety, anger, stress, depression, excitement). Similarly, the same critiques apply to the indicators of perceived risk. Nevertheless, the corresponding questions were ad-hoc formulated for the COVID-19 pandemic context and were similar to those used in other studies.^{52,72,73}

Conclusions

Getting vaccinated against COVID-19 is an individual choice, but individual choices have population-level effects that could challenge efforts to control the pandemic, which is why studying the factors that lead to VH is crucial. Many of the determinants already known in the scientific literature were confirmed, but the strength of our study lies in linking them together in a model that considered existing validated frameworks and focusing on the psychological impact of the pandemic and trust in information.

Being psychologically affected by the pandemic means being aware of one's responsibility to act against its consequences. Accepting vaccination could thus be an effective way not only to take care of oneself but also of the community.

Knowledge of the socio-demographic and psychological profiles of hesitant individuals, together with knowledge of the sources of information they access and their level of trust, provides important information for public health stakeholders to effectively design and adapt communication campaigns. As reducing VH is an important public health priority, interventions aimed at building trust, such as community-based public education, could be developed in order to improve understanding of the individual and social benefits of vaccination.

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